

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Applicants : Stephen Todd, et al. Art Unit : 2169
Serial No. : 10/024,796 Examiner : Sana A. Al Hashemi
Filed : December 19, 2001 Conf. No. : 6077
Title : WORKFLOW DATABASE FOR SCALABLE STORAGE SERVICE

MAIL STOP APPEAL BRIEF-PATENTS

Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF UNDER 37 C.F.R. § 41.37

In response to the final Office Action dated November 20, 2008 which finally rejected claims 1 to 23 in the above-identified application, please consider the arguments set forth below.

Claims currently in the application are provided as an attachment A1 hereto.

A. Real Party in Interest

EMC CORPORATION, a Massachusetts corporation having a place of business at 171 South Street, Hopkinton, MA 01748-9103 is the real party in interest by way of an assignment executed on December 12, 2001 and December 14, 2001 by the inventors and recorded on reel 012722, frame 0065 on March 15, 2002.

B. Related Appeals and Interferences

None.

C. Status of the Claims

Claims 1 to 23 remain rejected. Claims 1 to 23 are appealed. In particular, claims 1 to 22 are rejected under 35 U.S.C. §102(e) as being anticipated by Peters et al. (U.S. Patent Number 5,884,284 hereinafter “Peters”). Claim 23 stands rejected under 35 U.S.C. §103(a) as being obvious over Peters in view of Bromley et al (U.S. Patent Number 7,099,900 hereinafter “Bromley”).

D. Status of Amendments

No Amendments were filed subsequent to the Final Office Action dated November 20, 2008.

E. Summary of Claimed Subject Matter

Independent claim 1 is directed to a method of managing workflows in a service provider environment in which a service provider provides data storage resources 24a-24f to a customer (see, for example, FIG.1 of Applicants' specification). The method includes providing the customer with a list of types of work order requests to select work to be performed based on a permission level defining a level of access to the data storage resources 24a-24f allowed to the customer (see, for example, FIG. 8 and page 14, lines 18 to 20 of Applicants' specification). The work order requests include requests to manage configuration of the data storage resources provided to the customer (see, for example, page 11, lines 19 to 22 of Applicants' specification). The method also includes receiving a selection of a type of work order request from the customer prior to performance of work associated with the selection, enabling the customer to generate a work order request of the selected type in a work order request submission, creating a database object based on the work order request and storing the database object in a database 26 (see, for example, page 11, lines 19 to 21 of Applicants' specification). The list of the types of work order requests includes at least one of requests to create a mirror or to restore remote mirroring (see, for example, page 11, lines 19 to 22 of Applicants' specification).

Independent claim 21 is a computer program product claim having corresponding features to claim 1 (see, for example, FIGS. 1 and 8, page 11 lines 18 to 22 and page 14, lines 18 to 20 of Applicants' specification).

Independent claim 22 is an apparatus claim with all the elements being means-for claim elements under 35 U.S.C. § 112, paragraph 6 and having corresponding features to claim 1 (see, for example, FIGS. 1 and 8, page 11 lines 18 to 22 and page 14, lines 18 to 20 of Applicants' specification).

F. Grounds of Rejections to Be Reviewed On Appeal

1. Whether claims 1 to 22 are unpatentable under 35 U.S.C. §102(e) as being anticipated by Peters.
2. Whether dependent claim 23 is unpatentable under 35 U.S.C. §103(a) as being obvious over Peters in view of Bromley.

G. Argument.

1. Claims 1, 5, 7 to 11 and 14 to 22 are patentable under 35 U.S.C. §102(e) over Peters.

Claims 1 to 22 stand or fall together

Applicants respectfully submit that independent claims 1, 21 and 22 are not anticipated by Peters at least because Peters does not contain the claim elements discussed below for reasons described herein and in previous office action responses as noted below. Furthermore, it is submitted that the Examiner's inconsistent use of the claim terms constitutes a clear error in the rejection.

a) The cited art does not disclose or suggest all the claim elements to establish a *prima facie* case of anticipation.

Claim 1 is directed to a method of managing workflows in a service provider environment in which a service provider provides data storage resources to a customer. The method includes providing the customer with a list of types of work order requests to select work to be performed based on a permission level defining a level of access to the data storage resources allowed to the

customer. The work order requests include requests to manage configuration of the data storage resources provided to the customer. The method also includes receiving a selection of a type of work order request from the customer prior to performance of work associated with the selection, enabling the customer to generate a work order request of the selected type in a work order request submission, creating a database object based on the work order request and storing the database object in a database. The list of the types of work order requests includes at least one of requests to create a mirror or to restore remote mirroring.

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference" (Verdegaal Bros. v. Union Oil Co. of California, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987)).

i) Peters does not disclose or suggest the claim limitation of a list of the types of work order requests includes at least one of requests to create a mirror or to restore remote mirroring of independent claims 1, 21 and 22.

Peters discloses a system that "creates, maintains, processes and analyzes individual users for telecommunication services" (see Abstract of Peters). Peters does not disclose or suggest mirroring much less a list of the types of work requests that include creating a mirror or restoring a remote mirror. The Examiner has cited column 10, lines 22 to 29 of Peters as support for "restoring remote mirroring" (see page 3 of the Final Office Action date November 20, 2008) which recites:

The customer service functions provide the user with information needed to serve customers. These functions include the FCP function and the RMD function. The FCP function allows the user to perform certain functions when operating a draw or add systems front counter. The RMD function keeps track of the payment arrangements and miscellaneous

reminder messages that the user may have entered regarding the various subscriber accounts.

The Examiner's rationale states that "the method of allowing the user to access, modify and update work order remotely corresponds to the claimed limitation" (see page 3 of the Office Action dated November 20, 2008). Applicants submit that the Examiner's statement would not be understood by one of ordinary skill in the art at least because the cited passage mentions nothing about work order requests or restoring remote mirroring. In fact the Examiner has ignored the word "mirroring" in her rationale. Applicants respectfully submit that the terms "mirror" and "mirroring" have meaning to one of ordinary skill in the art. For instance, mirroring is a "means of protecting data ...by duplicating it, in its entirety on a second disk" (see page 293 of the Microsoft Computer Dictionary, Fourth Edition included herein) or, put another way, mirroring "is the replication of logical disk volumes onto separate physical hard disks in real time to ensure continuous availability" (http://en.wikipedia.org/wiki/Disk_mirroring included herein). Nothing in the cited passage in Peters teaches mirroring much less restoring remote mirroring whatsoever to one of ordinary skill in the art.

Rather than teaching creating a mirror or restoring a remote mirror, Peters teaches, in the cited passage, a Reminder Maintenance Display (RMD) function for tracking of the payment arrangements and miscellaneous reminder messages and a Front Counter Processing (FCP) function to allow a user "to perform certain functions when operating a draw or add systems front counter" (see column 10, lines 22 to 29 of Peters). Again, neither of these functions in Peters teaches restoring remote mirroring or creating a mirror. Therefore, Peters does not disclose or suggest a list of types of work order requests including at least one of requests to create a mirror or to restore remote mirroring as recited in claim 1.

In response to Applicants' arguments that the Examiner has ignored "mirroring" the Examiner introduced new support for her argument by stating that Peters discloses "duplicating" and refers Applicants to a portion of Peters (see page 9 of the Final Office Action dated November 20, 2008) that recites:

The print function allows the user to print a subscriber report, a copy of a work order or service order, an invoice, or a subscriber's transaction history. The function includes: printing a transaction history, printing a duplicate invoice, printing a current DPL screen, printing a trouble order, and printing a work order (column 8, lines 68 to column 9, line 4 of Peters).

Applicants respectfully submit that this section of Peters merely describes printing a duplicate invoice and printing a work order. This section of Peters does not mention mirroring or that printing a duplicate invoice can be selected from a list of types of work order requests alleged by the Examiner to be found at Column 19, lines 4 to 9 of Peters (see page 3 of the Final Office Action date November 20, 2008).

The Examiner also suggests that other portions in Peters teach mirroring (see page 9 of the Final Office action) such as the portion of Peters that recites:

Other databases are maintained for each CCI office for: alternate addresses, work orders, service orders, jobs, street names, franchise information, debit/credit codes, apartments, and campaigns. This is further shown in FIG. 11, and discussed below in the section hereof about FIG. 11 (see column 6, lines 32 to 37 of Peters).

However, this portion of Peters mentions nothing about mirroring or even that these work orders are from a list of types of work orders requests alleged by the Examiner to be found at Column 19, lines 4 to 9 of Peters (see page 3 of the Final Office Action date November 20, 2008).

Furthermore, if the Examiner is suggesting that "alternate addresses" is mirroring, then Applicants respectfully submit that the Examiner is mistaken. As one of ordinary skill in the art would appreciate, an alternate address is merely another address to locate a customer and is also called a secondary address and is not a copy of another address. Nor does an alternate address or any

other term in the cited section teach a list of types of work order requests including at least one of requests to create a mirror or to restore remote mirroring as recited in claims 1, 21 and 22.

Moreover, for the record, the Examiner has misstated Applicants' position with respect to mirroring by alleging that Applicants have said duplicating is mirroring (see page 9 of the Final Office Action date November 20, 2008). In particular, Applicants' previous Office Action response states that:

... the terms "mirror" and "mirroring" have meaning to one of ordinary skill in the art. For instance, mirroring is a "means of protecting data ... by duplicating it, in its entirety on a second disk" (see page 293 of the Microsoft Computer Dictionary, Fourth Edition included herein) or put another way "is the replication of logical disk volumes onto separate physical hard disks in real time to ensure continuous availability" (http://en.wikipedia.org/wiki/Disk_mirroring (emphasis added, see pages 3 and 4 of the Office Action response dated September 11, 2008)

The Examiner has only focused on the word "duplicating" and has ignored the complete sentence which includes "duplicating in its entirety on a second disk." Therefore, Peters does not teach mirroring or restoring remote mirroring, much less a list of types of work order requests including at least one of requests to create a mirror or to restore remote mirroring as recited in claims 1, 21 and 22.

Therefore, based on at least the foregoing remarks, the Examiner has not provided adequate support to show that Peters teaches a list of types of work order requests that including at least one of requests to create a mirror or to restore remote mirroring.

In view of the above, it is submitted that a proper *prima facie* anticipation rejection has not been made, at least because at least one of the claim elements discussed above is not taught by the cited reference. Accordingly, Applicants respectfully request that the art rejection be withdrawn.

ii) Peters does not disclose or suggest the claim limitation of “work order requests comprising requests to manage configuration of the data storage resources provided to the customer” of independent claims 1, 21 and 22.

The Examiner cites column 5, lines 42 to 46 of Peters (see page 3 of the Final Office Action dated November 20, 2008):

The supervisor or system administrator may choose to allow different levels of access to applications and subscriber information depending on a user's job description. Reports summarizing various subscriber and cable activities may be generated by users on terminals 56.

The Examiner has further stated that this:

... cited portion of Peters discloses the method of allowing the system administrator to choose to allow different levels of access to the application corresponds to the method of manage configuration since changing the level of access means changing the configuration. (see pages 9 and 10 of the Final Office Action dated November 20, 2008)

However, Applicants respectfully submit that this portion of Peters teaches nothing about work order requests much less work order requests that include requests to manage configuration of the data storage resources provided to a customer. Applicants respectfully submit that a system administrator is not a work order request using the plain meaning of the term.

Furthermore, the only storage resources mentioned in Peters is data storage 68, but none of the work order requests in Peters are related to data storage 68 (see, for example, FIG. 1 and Column 4, line 54 to Column 5, line 8 of Peters). Nor do Peters' work order requests involve any management of configuration of the data storage resources (see, for example, Column 19, lines 4 to 9 of Peters which the Examiner has indicated teaches a list of types of work order requests (page 3 of the Final Office Action dated November 20, 2008) and column 5, lines 42 to 46 which the Examiner has indicated teaches work order requests to manage configuration of the data

storage resources provide to the customer (page 3 of the Final Office Action dated November 20, 2008)). Therefore, Peters does not teach that work order requests including requests to manage configuration of data storage resources provided to a customer.

b) The Examiner has not reasonably used interpretations of claim terms consistently in Peters for claims 1, 21 and 22.

In particular, the Examiner has not used consistently the recited “list of the types of work order requests” so that the claim limitation of “the list of the types of work order requests includes at least one of requests to create a mirror or to restore remote mirroring” in independent claims 1, 21 and 23 is not found in Peters.

The Examiner has stated that a list of the types of work order requests is taught in Peters (see page 3 of the Final Office Action dated November 20, 2008) which recites:

Turning back to FIG. 12, a typical report menu according to the present invention would give the user choices between several reports to generate. Once a user selects a specific report to be generated, the information relevant to the report is compiled by the server 66 from the files stored in central storage device 68 (see Column 19, lines 4 to 9 of Peters).

FIG. 12 of Peters depicts a list that includes a Returned Work Order Report; Scheduled Work Order Report; Daily Activity Report; Drop Burial List; Drop Burial Past Due List; Drop Burial Summary; Pending Disconnect Work Order Request; Multiple Orders, Same Address; Repeat Call Report and Unscheduled Work Order Report (See FIG. 12 of Peters). However, none of these alleged types of work order requests in this list mentions mirroring much less restoring remote mirroring.

The Examiner parsed the claim limitation that includes “the list of the types of work order requests includes at least one of requests to create a mirror or to restore remote mirroring” into

two parts. The Examiner alleges that support for the first portion of the parsed phrase that includes "list of the types of works requests comprise at least one of requests to" is taught in Peters (see page 3 of the Final Office Action) which recites:

The databases are maintained, processed, analyzed, and a variety of reports and bills are generated. In the CCI preferred embodiment, the functions are categorized as (1) DPL (display) User functions, (2) SAM menu user functions, and (3) supervisor functions and reports. The DPL user functions and SAM menu user functions are intended primarily for review or modification of individual data records (see Column 7, lines 44 to 51 of Peters).

The Examiner further alleges that this portion of Peters teaches "the method of displaying al[sic] functions corresponds to list of the types of work order requests" (see page 3 of the Final Office Action date November 20, 2008). However, this cited portion of Peters does not teach work orders or work orders requests at all. Also, this cited portion of Peters does not teach a list of the types of works orders requests alleged by the Examiner to be found at Column 19, lines 4 to 9 of Peters nor is there any logical relationship with that section of Peters at all.

For the second portion of the parsed phrase, the Examiner alleges that support for "restoring remote mirroring" is taught in Peters (see page 3 of the Office Action) by citing:

The customer service functions provide the user with information needed to serve customers. These functions include the FCP function and the RMD function. The FCP function allows the user to perform certain functions when operating a draw or add systems front counter. The RMD function keeps track of the payment arrangements and miscellaneous reminder messages that the user may have entered regarding the various subscriber accounts (see column 10, lines 22 to 29 of Peters).

The Examiner's rationale states that "the method of allowing user [sic] to access and update work order [sic] remotely corresponds to the claimed limitation" (see page 3 of the Final Office Action). Again, this cited portion of Peters mentions nothing about work order requests much less a list of the types of works order requests that the Examiner alleges are found at Column 19, lines

4 to 9 of Peters. Furthermore, this cited portion has nothing to do with the first parsed portion found at column 7, lines 49 to 51 of Peters.

Moreover, Applicants submit that one of ordinary skill in the art would not have looked to the Peters reference to find the recited claim elements. Applicants' claims are directed towards work order requests related to data storage resources whereas Peters does include work orders but they refer to work orders to provide telecommunications service to a customer. The only storage resources mentioned in Peters is data storage 68 and though the user has access to data storage, none of the work order requests are related to data storage 68 (see, for example, FIG. 1 and Column 4, line 54 to Column 5, line 8 of Peters). Applicants note that presumably the Examiner found this reference because she performed a search with "work order" as a search term; however her analysis completely ignores what the term "work order" means and how it is actually used in the Peters reference. Instead, the Examiner has focused on other portions of Peters not related to work orders themselves. The Examiner has justified her approach by stating that "it is a well settled rule that a reference must be considered not only for what it expressly teaches but also what it fairly suggests" and "it is equally well settled rule that what a reference can be said to fairly suggest relates to the concepts fairly contained, and is not limited by the specific structure chosen to illustrate such concepts" (see pages 8 and 9 of the Final Office Action date November 20, 2008). However, the Examiner has failed to recognize that the operative words are "fairly suggests." One of ordinary skill in the art could not possibly have found that the Peters reference "fairly suggests" work order requests comprising requests to manage configuration of data storage resources provided to a customer or a list of types of work order requests including at least one of requests to create a mirror or to restore remote mirroring. Instead, the Examiner has misapplied sections of Peters not related to work orders taught by Peters to justify her conclusions. Thus, by

citing art that has no relevance to Applicants' claimed invention, the Examiner has drawn conclusions different from what one of ordinary skill in the art would conclude.

Applicants respectfully submit that the Examiner's use of claim terms in the Examiner's analysis of the Peters reference is inconsistent and constitutes a clear error in the rejection. Therefore, Applicants respectfully submit that the analysis and the rejection are flawed.

Claims 2 to 20 depend from and thus include the limitations of claim 1. Applicants submit that the Peters reference should be withdrawn with respect to 2 to 20 for at least the foregoing reasons presented for claim 1.

In view of the above, it is submitted that a proper *prima facie* rejection has not been made, at least because not all of the claim elements of independent claims 1, 21 and 22 as discussed above are not disclosed or suggested in Peters. Furthermore, because the Examiner has not provided consistent rationale for identifying the claim terms in the art understandable by one of ordinary skill in the art, it is submitted that there is clear error in the rejection. Accordingly, Applicants respectfully request that the art rejection be withdrawn.

2. Dependent claim 23 is patentable under 35 U.S.C. § 103(a) over Peters in view of Bromley.

Dependent claim 23 depends on independent claim 22. Applicants respectfully submit that claim 23 is allowable for at least the same foregoing reasons presented with respect to claim 22.

Applicants : Stephen Todd et al.
Serial No. : 10/024,796
Filed : December 19, 2001
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Attorney's Docket No.: EMC-034PUS

H. Claims Appendix

See attachment A1.

I. Evidence Appendix

None.

J. Related Proceedings

None.

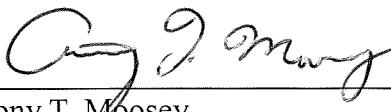
Conclusion

In view of the above, Applicants submit that Claims 1 to 23 and the entire case are in condition for allowance and should be sent to issue and such action is respectfully requested.

Enclosed is an electronic payment of the fee for filing a brief in support of an appeal and a one-month extension of time fee. No other fees are believed due; however, if any other fees are due, please apply such fees to Deposit Account No. 50-0845 referencing Attorney Docket: EMC-034PUS.

Respectfully submitted,

Date: 18 May 2007



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Attachments:

- A1. Claims currently in the application
- A2. Verdegaal Bros. v. Union Oil Co. of California, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987)
- A3. Page 293 of the Microsoft Computer Dictionary, Fourth Edition
- A4. Web page from http://en.wikipedia.org/wiki/Disk_mirroring

A1: Claims Currently in the Application

LISTING OF CLAIMS:

- 1 1. (Previously Presented) A method of managing workflows in a service provider environment in which a service provider provides data storage resources to a customer, comprising:
 - 4 providing the customer with a list of types of work order requests to select work to be
 - 5 performed based on a permission level defining a level of access to the data storage resources
 - 6 allowed to the customer, the work order requests comprising requests to manage configuration of
 - 7 the data storage resources provided to the customer, wherein the list of the types of work order
 - 8 requests comprises at least one of requests to:
 - 9 create a mirror; or
 - 10 restore remote mirroring;
 - 11 receiving a selection of a type of work order request from the customer prior to
 - 12 performance of work associated with the selection;
 - 13 enabling the customer to generate a work order request of the selected type in a work order
 - 14 request submission;
 - 15 creating a database object based on the work order request; and
 - 16 storing the database object in a database.
- 1 2. (Original) The method of claim 1, wherein enabling comprises:

2 providing to the customer at least one task screen corresponding to the selected type of
3 work order request and usable by the customer to generate the work order request.

1 3. (Original) The method of claim 1, wherein the work order request comprises values of
2 parameters specific to the selected type of work order request.

1 4. (Original) The method of claim 1, wherein the database object comprises elements that
2 include a customer identifier and the selected type of work order request.

1 5. (Original) The method of claim 4, wherein the elements further include a state to
2 indicate status of the work order request.

1 6. (Previously Presented) The method of claim 5, wherein the state is set to indicate a
2 new work order request initially and later changed to indicate a closed work order request.

1 7. (Original) The method of claim 5, further comprising:
2 assigning a work order request identifier to the work order request; and
3 providing the assigned work order request to the customer.

1 8. (Original) The method of claim 7, wherein the database object is stored in the database
2 as a table entry, the table entry including fields to store information associated with each of the
3 elements.

1 9. (Original) The method of claim 8, wherein the elements further comprise the assigned
2 work order request identifier and the work order request is stored in one of the fields in the table
3 entry.

1 10. (Previously Presented) The method of claim 9, further comprising:
2 processing the work order request using the table entry, processing comprising attempting
3 to perform any tasks required to satisfy the work order request; and
4 updating the state based on the results of the processing.

1 11. (Previously Presented) The method of claim 10, wherein updating comprises:
2 marking the state to indicate that the work order request is closed if such tasks are
3 performed successfully; and
4 marking the state to indicate a failure if such tasks are not performed successfully.

1 12. (Original) The method of claim 10, further comprising:
2 generating a billable event when the work order request is closed; and
3 storing the billable event in the database in association with the customer identifier and
4 account information.

1 13. (Original) The method of claim 1, wherein work order request submission is in the
2 form of an email.

1 14. (Original) The method of claim 1, wherein work order request submission is in the
2 form of HTTP.

1 15. (Original) The method of claim 10, wherein processing is managed by a workflow
2 automation that periodically queries the database to locate any new work order requests based on
3 the state in the table entry for each work order request.

1 16. (Currently Amended) The method of claim 15, wherein the processing, updating, and
2 the generating and storing of the billable event are handled by the workflow automation.

1 17. (Original) The method of claim 15, wherein the workflow automation invokes other
2 processes needed to perform the work order request.

1 18. (Original) The method of claim 10, wherein processing is managed manually by an
2 administrator of the service provider.

1 19. (Previously Presented) The method of claim 18, wherein the processing, updating,
2 and the generating and storing of the billable event are handled manually by the service provider
3 administrator.

1 20. (Previously Presented) The method of claim 18, wherein the processing, updating,
2 and the generating and storing of billable events are managed manually by the service provider
3 administrator when the state indicates a failure.

1 21. (Previously Presented) A computer program product residing on a computer-readable
2 medium for managing workflows in a service provider environment in which a service provider

3 provides data storage resources to a customer, the computer program product comprising
4 instructions causing a computer to:

5 provide the customer with a list of types of work order requests to select work to be
6 performed based on a permission level defining a level of access to the data storage resources
7 allowed to the customer, the work order requests comprising requests to manage configuration of
8 the data storage resources provided to the customer, wherein the list of types of work order
9 requests comprises at least one of requests to:

10 create a mirror; or

11 restore remote mirroring;

12 receive a selection of a type of work order request from the customer prior to performance
13 of work associated with the selection;

14 enable the customer to generate a work order request of the selected type in a work order
15 request submission;

16 create a database object based on the work order request; and

17 store the database object in a database.

1 22. (Previously Presented) An apparatus for managing workflows in a service provider
2 environment in which a service provider provides data storage resources to a customer,
3 comprising:

4 means for providing a customer with a list of types of work order requests to select work
5 to be performed based on a permission level defining a level of access to the data storage
6 resources allowed to the customer, the work order requests comprising requests to manage
7 configuration of the data storage resources provided to the customer, wherein the list of the types
8 of work order requests comprises at least one of requests to:

9 create a mirror; or

10 restore remote mirroring;

11 means for receiving a selection of a type of work order request from the customer prior to

12 performance of work associated with the selection;

13 means for enabling the customer to generate a work order request of the selected type in a

14 work order request submission;

15 means for creating a database object based on the work order request; and

16 means for storing the database object in a database.

1 23. (Previously Presented) The method of claim 1 wherein the list of the types of work

2 order requests further comprises requests to split a business continuance volume (BCV).

Attachment - A2
Appeal Brief
App. No. 10/024,796

Page 1

LEXSEE 814 F. 2D 628

**Verdegaal Brothers, Inc., William Verdegaal, George Verdegaal, Appellees, v. Union
Oil Company of California, BREA Agricultural Services, Inc., Appellants**

No. 86-1258

UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

814 F.2d 628; 1987 U.S. App. LEXIS 175; 2 U.S.P.Q.2D (BNA) 1051

March 12, 1987, Decided

PRIOR HISTORY: [1]**

Appealed from U.S. District Court for the Eastern District of California, Judge Coyle.

DISPOSITION:

Reversed.

COUNSEL:

Andrew J. Belansky, Christie, Parker & Hale, argued for Appellants. With him on the brief was David A. Dillard.

John P. Sutton, Limbach, Limbach & Sutton, argued for Appellee. With him on the brief was Michael E. Dergosits.

JUDGES:

Markey, Chief Judge, and Davis and Nies, Circuit Judges.

OPINION:

[*630] NIES, Circuit Judge.

Union Oil Company of California and Brea Agricultural Services, Inc. (collectively Union Oil) appeal from a judgment of the United States District Court for the Eastern District of California, No. CV-F-83-68 REC, entered on a jury verdict which declared U.S. Patent No. 4,310,343 ('343), owned by Verdegaal Brothers, Inc., "valid" and claims 1, 2, and 4 thereof infringed by Union Oil. Union Oil's motion for

judgment notwithstanding the verdict (JNOV) was denied. We reverse.

I

BACKGROUND

The General Technology

The patent in suit relates to a process for making certain known urea-sulfuric acid liquid fertilizer products. These products are made by reacting water, urea (a nitrogen-containing chemical), and sulfuric acid (a sulfur-containing [**2] chemical) in particular proportions. The nomenclature commonly used by the fertilizer industry refers to these fertilizer products numerically according to the percentages by weight of four fertilizer constituents in the following order: nitrogen, phosphorous, potassium, and sulfur. Thus, for example, a fertilizer containing 28% nitrogen, no phosphorous or potassium, and 9% sulfur is expressed numerically as 28-0-0-9.

The Process of the '343 Patent

The process disclosed in the '343 patent involves the chemical reaction between urea and sulfuric acid, which is referred to as an exothermic reaction because it gives off heat. To prevent high temperature buildup, the reaction is conducted in the presence of a nonreactive, nutritive heat sink which will absorb the heat of reaction. Specifically, a previously-made batch of liquid fertilizer -- known as a "heel" -- can serve as the heat sink to which more reactants are added. Claims 1 and 2 are representative:

814 F.2d 628, *630; 1987 U.S. App. LEXIS 175, **2;
2 U.S.P.Q.2D (BNA) 1051

1. In a process for making a concentrated liquid fertilizer by reacting sulfuric acid and urea, to form an end product, the improvement comprising:

- a. providing a non-reactive, nutritive heat sink, capable [**3] of dissipating the heat of urea and sulfuric acid, in an amount at least 5% of the end product,
- b. adding water to the heat sink in an amount not greater than 15% of the end product,
- c. adding urea to the mixture in an amount of at least 50% of the total weight of the end product,
- d. adding concentrated sulfuric acid in an amount equal to at least 10% of the total weight of the end product.

2. The process of claim 1 wherein the heat sink is recycled liquid fertilizer.

Procedural History

Verdegaal brought suit against Union Oil in the United States District Court for the Eastern District of California charging that certain processes employed by Union Oil for making liquid fertilizer products infringed all claims of its '343 patent. Union Oil defended on the grounds of noninfringement and patent invalidity under 35 U.S.C. §§ 102, 103. The action was tried before a jury which returned a verdict consisting of answers to five questions. Pertinent here are its answers that the '343 patent was "valid" over the prior art, and that certain of Union Oil's processes infringed claims 1, 2, and 4 of the patent. None were found to infringe [**4] claims 3 or 5. Based on the jury's verdict, the district court entered judgment in favor of Verdegaal.

Having unsuccessfully moved for a directed verdict under Fed. R. Civ. P. 50(a), Union Oil timely filed a motion under Rule 50(b) for JNOV seeking a judgment

that the claims of the '343 patent were invalid [**631] under sections 102 and 103. The district court denied the motion without opinion.

II

ISSUE PRESENTED

Did the district court err in denying Union Oil's motion for JNOV with respect to the validity of claims 1, 2, and 4 of the '343 patent?

III

Standard of Review

When considering a motion for JNOV a district court must: (1) consider all of the evidence; (2) in a light most favorable to the non-moving party; (3) drawing all reasonable inferences favorable to that party; (4) without determining credibility of the witnesses; and (5) without substituting its choice for that of the jury's in deciding between conflicting elements of the evidence. *Railroad Dynamics, Inc. v. A. Stucki Co.*, 727 F.2d 1506, 1512-13, 220 U.S.P.Q. (BNA) 929, 936 (Fed. Cir. [**5]), cert. denied, 469 U.S. 871, 83 L. Ed. 2d 150, 105 S. Ct. 220, 224 U.S.P.Q. (BNA) 520 (1984); *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1546, 220 U.S.P.Q. (BNA) 193, 197 (Fed. Cir. 1983). A district court should grant a motion for JNOV only when it is convinced upon the record before the jury that reasonable persons could not have reached a verdict for the nonmoving party. *Railroad Dynamics*, 727 F.2d at 1513, 220 U.S.P.Q. (BNA) at 936; *Connell*, 722 F.2d at 1546, 220 U.S.P.Q. (BNA) at 197.

To reverse the district court's denial of the motion for JNOV, Union Oil must convince us that either the jury's factual findings are not supported by substantial evidence, or, if they are, that those findings cannot support the legal conclusions which necessarily were drawn by the jury in forming its verdict. See *Perkin-Elmer Corp. v. Computervision Corp.*, 732 F.2d 888, 893, 221 U.S.P.Q. (BNA) 669, 673 (Fed. Cir.), cert. denied, 469 U.S. 857, 83 L. Ed. 2d 120, 105 S. Ct. 187 (1984), *Railroad Dynamics*, 727 F.2d at 1512, 220 U.S.P.Q. (BNA) at 936. [**6] Substantial evidence is more than just a mere scintilla; it is such relevant evidence from the record taken as a whole as a reasonable mind might accept as adequate to support the finding under review. *Consolidated Edison Co. v. NLRB*, 305

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U.S. 197, 229, 83 L. Ed. 126, 59 S. Ct. 206 (1938); *Perkin-Elmer*, 732 F.2d at 893, 221 U.S.P.Q. (BNA) at 673; *SSIH Equip. S.A. v. U.S. Int'l Trade Comm'n*, 718 F.2d 365, 371 n.10, 218 U.S.P.Q. (BNA) 678, 684 n.10 (Fed. Cir. 1983). A trial court's denial of a motion for JNOV must stand unless the evidence is of such quality and weight that reasonable and fair-minded persons in the exercise of impartial judgment could not reasonably return the jury's verdict. *Envirotech Corp. v. Al George, Inc.*, 730 F.2d 753, 758, 221 U.S.P.Q. (BNA) 473, 477 (Fed. Cir. 1984).

Our precedent holds that the presumption of validity afforded a U.S. patent by 35 U.S.C. § 282 requires that the [**7] party challenging validity prove the facts establishing invalidity by clear and convincing evidence. *American Hoist & Derrick Co. v. Sowa & Sons, Inc.*, 725 F.2d 1350, 1360, 220 U.S.P.Q. (BNA) 763, 770 (Fed. Cir.), cert. denied, 469 U.S. 821, 83 L. Ed. 2d 41, 105 S. Ct. 95 (1984). Thus, the precise question to be resolved in this case is whether Union Oil's evidence is so clear and convincing that reasonable jurors could only conclude that the claims in issue were invalid. See *Perkin-Elmer*, 732 F.2d at 893, 221 U.S.P.Q. (BNA) at 673; *Railroad Dynamics*, 727 F.2d at 1511, 220 U.S.P.Q. (BNA) at 935.

Anticipation

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. See, e.g., *Structural Rubber Prods. Co. v. Park Rubber Co.*, 749 F.2d 707, 715, 223 U.S.P.Q. (BNA) 1264, 1270 (Fed. Cir. 1984); *Connell*, 722 F.2d at 1548, 220 U.S.P.Q. (BNA) at 198; *Kalman v. Kimberly-Clark Corp.*, 713 F.2d 760, 771, 218 U.S.P.Q. (BNA) 781, 789 (Fed. Cir. 1983), [**8] cert. denied, 465 U.S. 1026, 79 L. Ed. 2d 687, 104 S. Ct. 1284, 224 U.S.P.Q. (BNA) 520 (1984). Union Oil asserts that the subject claims of the '343 patent [*632] are anticipated under 35 U.S.C. § 102(e) n1 by the teachings found in the original application for U.S. Patent No. 4,315,763 to Stoller, which the jury was instructed was prior art.

n1 Section 102(e) provides:

A person shall be entitled to a patent unless -- . . .

(e) the invention was

described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent. . . .

From the jury's verdict of patent validity, we must presume [**9] that the jury concluded that Union Oil failed to prove by clear and convincing evidence that claims 1, 2, and 4 were anticipated by the Stoller patent. See *Perkin-Elmer*, 732 F.2d at 893, 221 U.S.P.Q. (BNA) at 673; *Railroad Dynamics*, 727 F.2d at 1516, 220 U.S.P.Q. (BNA) at 939. Under the instructions of this case, this conclusion could have been reached only if the jury found that the Stoller patent did not disclose each and every element of the claimed inventions. Having reviewed the evidence, we conclude that substantial evidence does not support the jury's verdict, and, therefore, Union Oil's motion for JNOV on the grounds that the claims were anticipated should have been granted.

The Stoller patent discloses processes for making both urea-phosphoric acid and urea-sulfuric acid fertilizers. Example 8 of Stoller specifically details a process for making 30-0-0-10 urea-sulfuric acid products. There is no dispute that Example 8 meets elements b, c, and d of claim 1, specifically the steps of adding water in an amount not greater than 15% of the product, urea in an amount of at least 50% of the product, and concentrated sulfuric acid in an amount [**10] of at least 10% of the product. Verdegaal disputes that Stoller teaches element a, the step of claim 1 of "providing a non-reactive, nutritive heat sink." As set forth in claim 2, the heat sink is recycled fertilizer. n2

n2 Claim 4 is written in terms of approximate percentages of all reactants by weight of the end product. No argument is made that the process of claim 4 would result in a fertilizer product any different from that disclosed by Example 8 of Stoller.

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2 U.S.P.Q.2D (BNA) 1051

The Stoller specification, beginning at column 7, line 30, discloses:

Once a batch of liquid product has been made, it can be used as a base for further manufacture. This is done by placing the liquid in a stirred vessel of appropriate size, adding urea in sufficient quantity to double the size of the finished batch, adding any water required for the formulation, and slowly adding the sulfuric acid while stirring. Leaving a heel of liquid in the vessel permits further manufacture to be conducted in a stirred fluid mass.

This portion [**11] of the Stoller specification explicitly teaches that urea and sulfuric acid can be added to recycled fertilizer, i.e., a heel or base of previously-made product. Dr. Young, Union Oil's expert, so testified. Verdegaal presented no evidence to the contrary.

Verdegaal first argues that Stoller does not anticipate because in Stoller's method sulfuric acid is added *slowly*, whereas the claimed process allows for rapid addition. However, there is no limitation in the subject claims with respect to the rate at which sulfuric acid is added, and, therefore, it is inappropriate for Verdegaal to rely on that distinction. *See SSIH*, 718 F.2d at 378, 218 U.S.P.Q. (BNA) at 689. It must be assumed that slow addition would not change the claimed process in any respect including the function of the recycled material as a heat sink.

Verdegaal next argues that the testimony of Union Oil's experts with respect to what Stoller teaches could well have been discounted by the jury for bias. Discarding that testimony does not eliminate the reference itself as evidence or its uncontradicted disclosure that a base of recycled fertilizer in a process may be used to make more of the product. [**12]

Verdegaal raises several variations of an argument, all of which focus on the [*633] failure of Stoller to explicitly identify the heel in his process as a "heat sink." In essence, Verdegaal maintains that because Stoller did not recognize the "inventive concept" that the heel functioned as a heat sink, Stoller's process cannot anticipate. This argument is wrong as a matter of fact and law. Verdegaal's own expert, Dr. Bahne, admitted that

Stoller discussed the problem of high temperature caused by the exothermic reaction, and that the heel could function as a heat sink. n3 In any event, Union Oil's burden of proof was limited to establishing that Stoller disclosed the same process. It did not have the additional burden of proving that Stoller recognized the heat sink capabilities of using a heel. Even assuming Stoller did not recognize that the heel of his process functioned as a heat sink, that property was inherently possessed by the heel in his disclosed process, and, thus, his process anticipates the claimed invention. *See In re Oelrich*, 666 F.2d 578, 581, 212 U.S.P.Q. (BNA) 323, 326 (CCPA 1981); *In re Swinehart*, 58 C.C.P.A. 1027, 439 F.2d 210, 212-13, 169 U.S.P.Q. (BNA) 226, 229 (CCPA 1971). [**13] The pertinent issues are whether Stoller discloses the process of adding urea and sulfuric acid to a previously-made batch of product, and whether that base would in fact act as a heat sink. On the entirety of the record, these issues could only be resolved in the affirmative.

n3 There is no dispute that the percentage of heel described in Stoller meets the percentage of heat sink required by the claims.

On appeal Verdegaal improperly attempts to attack the status of the Stoller patent as prior art, stating in its brief:

Verdegaal also introduced evidence at trial that the Stoller patent is not prior art under 35 U.S.C. §§ 102(e)/103. Professor Chisum testified that the Stoller patent, in his opinion, was not prior art. . . . This conclusion finds support in *In re Wertheim*, 646 F.2d 527, 209 U.S.P.Q. (BNA) 554 (CCPA 1981), and 1 Chisum on Patents § 3.07[3].

Appellee Brief at 27 (record cite omitted). Seldom have we encountered such blatant distortion [**14] of the record. A question about the status of the Stoller disclosure as prior art did arise at trial. Union Oil asserted that, even though the Stoller patent issued after the '343 patent, Stoller was prior art under section 102(e) as of its filing date which was well before the filing date of Verdegaal's application. Professor Chisum never testified that the Stoller patent was *not* prior art, but rather, stated

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that *he did not know* whether it was prior art. An excerpt from the pertinent testimony leaves no doubt on this point:

Q. (Mr. Sutton): And do you know whether the Stoller patent is prior art to the application of the Verdegaal patent?

A. (Prof. Chisum): I don't know that it is, no.

We find it even more incredible that Verdegaal would attempt to raise an issue with respect to the status of the Stoller patent given that the case was submitted to the jury with the instruction that the original Stoller patent application was prior art. n4 Verdegaal made no objection to that instruction below, and in its appeal briefs, the instruction is cavalierly ignored.

n4 The jury instruction read:

Stoller filed two patent applications -- an original application on October 30th, 1978, and a second on February 7th, 1980. Under the patent laws, the claims of the 343 patent are invalid if you find that the original application (Exhibit BL) anticipates the process claimed in the 343 patent.

[**15]

In sum, Verdegaal is precluded from arguing that the Stoller patent should not be considered prior art. *See Fed. R. Civ. P. 51; Weinar v. Rollform Inc.*, 744 F.2d 797, 808, 223 U.S.P.Q. (BNA) 369, 375 (Fed. Cir. 1984), *cert. denied*, 470 U.S. 1084, 105 S. Ct. 1844, 85 L. Ed. 2d 143 (1985); *Bio-Rad Laboratories, Inc. v. Nicolet Instrument Corp.*, 739 F.2d 604, 615, 222 U.S.P.Q. (BNA) 654, 662 (Fed. Cir.), *cert. denied*, 469 U.S. 1038, 83 L. Ed. 2d 405, 105 S. Ct. 516 (1984). n5

n5 Union Oil also argues that Verdegaal's counsel misled the jury by its closing rebuttal

argument:

But I think it's important to keep in mind that [Stoller] couldn't have been a prior patent because it issued a month after the Verdegaal patent had issued.

We disapprove of Verdegaal's tactic which would form the basis for a grant of a motion for a new trial but for our conclusion that outright reversal of the ruling on the motion for JNOV is in order.

[**16]

[*634] After considering the record taken as a whole, we are convinced that Union Oil established anticipation of claims 1, 2, and 4 by clear and convincing evidence and that no reasonable juror could find otherwise. Consequently, the jury's verdict on validity is unsupported by substantial evidence and cannot stand. Thus, the district court's denial of Union Oil's motion for JNOV must be reversed.

Conclusion

Because the issues discussed above are dispositive of this case, we do not find it necessary to reach the other issues raised by Union Oil. n6 In accordance with this opinion, we reverse the portion of the judgment entered on the jury verdict upholding claims 1, 2, and 4 of the '343 patent as valid under section 102(e) and infringed.

n6 It should not be inferred that all of these issues were properly before us. Union Oil appears to assume that on appeal it may dispute the resolution of any *issue* which is denominated an "issue of law" even though it was not raised in its motion for JNOV. This is incorrect. *See Railroad Dynamics*, 727 F.2d at 1511, 220 U.S.P.Q. (BNA) at 934.

[**17]

REVERSED.

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ed.
on
st,
nd *html*. A MIME type
t contains text written

nd *TIP*, and both Web
se MIME to interpret
ive. *See also* *HTTP*,
answer Protocol, Web

definition 1).

d familiarity of a prod-
e minds of users or
are, which is the per-

1 a particular product,
are a less quantifi-
in engaging customer
s. The term is used
ed to, the computer

l development of integrated
ng the size and increas-
nd other elements on a
providing the benefits
of electronic circuits

educes heat, and short-
of signals from one
& also integrated cir-

computer built to per-
while dealing efficiently
output from users con-
puters also frequently
rs on a network and
ll the attached machines.
vily in transaction-
s interfaces between
s and wide area networks.

e computer, microcom-
rea network. *Compare*
ion (definition 2).

n architecture in Win-
8, and Windows NT
a relatively small and
y additional instructions
re device, to interface
that class of devices.

ppy disk. *See also*

ser interface, to hide a
name for the window is placed on the desktop; when
the user clicks on the button, icon, or name, the window
is restored to its previous size. *See also* graphical user interface, Minimize button, taskbar, window.
Compare maximize.

Minimize button *n.* In Windows 3.x, Windows 9x, Windows NT, and Windows 2000, a button in the upper right-hand corner of a window that when clicked hides the window. In Windows 3.x and Windows NT 3.5 and earlier, an icon appears on the desktop that represents the window; in Windows 95, Windows NT 4.0, and later versions, the name of the window appears on the taskbar at the bottom of the desktop screen. When the icon or the name is clicked, the window is restored to its previous size.

See also graphical user interface, taskbar, window.

mini-notebook *n.* A portable computer in a case smaller than that of a standard laptop computer. Most mini-notebook computers have small keyboards, LCD screens built into folding cases, Pentium processors, and built-in hard drives. They are designed to run standard operating systems, such as Windows 98, rather than the Windows CE operating system used by the even smaller handheld computers.

miniport drivers *n.* Drivers containing device-specific information that communicate with non-device-specific port drivers, which in turn communicate with the system. *See also* driver.

minitower *n.* A vertical floor-standing computer cabinet that is about half the height (13 inches) of a tower case (24 inches). *See also* tower.

minor key *n.* *See* alternate key (definition 1).

MIP mapping *n.* Short for multum in parvo (Latin, “much in little”) mapping. A form of mapping in

which the appearance of a bitmapped image is precalculated from a distance and used in a texture mapper. This allows for smoother texture-mapped images calculated in the distance, since pixel conversion may alter colors relative to human perception.

MIPS (unips) *n.* Acronym for millions of instructions per second. A common measure of processor speed. *See also* central processing unit, MFLOPS.

mirror image *n.* An image that is an exact duplicate of the original with the exception that one dimension is reversed. For example, a right-pointing arrow and a left-pointing arrow of the same size and shape are mirror images.

mirroring *n.* 1. In computer graphics, the ability to display a mirror image of a graphic—a duplicate rotated or reflected relative to some reference such as an axis of symmetry. See the illustration. 2. In a network, a means of protecting data on a network by duplicating it, in its entirety, on a second disk. Mirroring is one strategy implemented in RAID security.

3. On the Internet, replicating a Web site or FTP site on another server. A site is often mirrored if it is frequently visited by multiple users. This eases the network traffic to the site, making it easier for users to gain access to the information or files on it. A site may also be mirrored in different geographic locations to facilitate downloading by users in various areas. *See also* RAID.

mirror site *n.* A file server that contains a duplicate set of files to the set on a popular server. Mirror sites exist to spread the distribution burden over more than one server or to eliminate the need to use high-demand international circuits.

MIS *n.* *See* IS.

misc. newsgroups *n.* Usenet newsgroups that are part of the misc. hierarchy and have the prefix misc. These newsgroups cover topics that do not fit into the other standard Usenet hierarchies (comp., news, rec., sci., soc., talk.). *See also* newsgroup, traditional newsgroup hierarchy, Usenet.

MNP10 *n.* Short for Microcom Networking Protocol, Class 10. An industry-standard communication pro-

mission critical *adj.* Pertaining to information, equipment, or other assets of a business or project that are essential to the successful operation of the organization. For example, accounting data and customer records are often mission critical information.

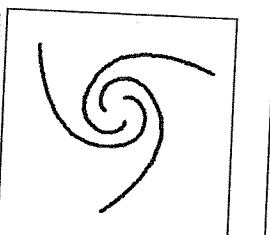
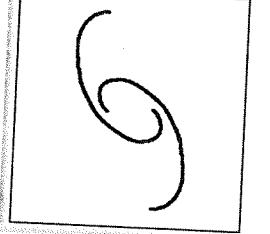
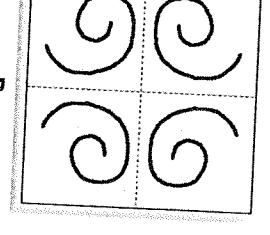
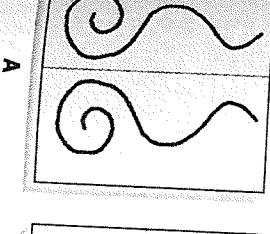
mixed cell reference *n.* In spreadsheets, a cell reference (the address of a cell needed to solve a formula) in which either the row or the column is relative (automatically changed when the formula is copied or moved to another cell) while the other is absolute (not changed when the formula is copied or moved). *See also* cell (definition 1).

MMU *n.* *See* memory management unit.

MMX *n.* Short for Multimedia Extensions. An enhancement to the architecture of Intel Pentium processors that improves the performance of multimedia and communications applications.

mnemonic (mē-mōn'ik) *n.* A word, rhyme, or other memory aid used to associate a complex or lengthy set of information with something that is simple and easy to remember. Mnemonics are widely used in computing. Programming languages other than machine language, for example, are known as *symbolic languages* because they use short mnemonics, such as ADD (for *addition*) and DEF (for *define*) to represent instructions and operations. Similarly, operating systems and applications based on typed commands use mnemonics to represent instructions to the program. MS-DOS, for example, uses DIR (for *directory*) to request a list of files.

MNP10 *n.* Short for Microcom Networking Protocol, Class 10. An industry-standard communication pro-



Mirroring (A) *Two-fold symmetry with vertical axis; (B) four-fold symmetry with vertical and horizontal axes; (C) four-fold*

radial symmetry; (D) three-fold symmetry with vertical and horizontal axes

Disk mirroring

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From Wikipedia, the free encyclopedia

In data storage, **disk mirroring** or **RAID1** is the replication of logical disk volumes onto separate physical hard disks in real time to ensure continuous availability. A **mirrored volume** is a complete logical representation of separate volume copies.

In a Disaster Recovery context, mirroring data over long distance is referred to as storage replication. Depending on the technologies used, replication can be performed synchronously, asynchronously, semi-synchronously, or point-in-time. Replication is enabled via microcode on the disk array controller or via server software. It is typically a proprietary solution, not compatible between various storage vendors.

Mirroring is typically only synchronous. Synchronous writing typically achieves a Recovery Point Objective of zero lost data. Asynchronous replication can achieve an RPO of just a few seconds while the remaining methodologies provide an RPO of a few minutes to perhaps several hours.

Mirroring is different from file shadowing.

Contents

- 1 Explanation
- 2 Other benefits of mirroring
- 3 Other schemes
- 4 See also
- 5 External links

Explanation

It is recognised that disks are an inherently unreliable component of computer systems. Mirroring is a technique to allow a system to automatically maintain multiple copies of data so that in the event of a disk hardware failure a system can continue to process or quickly recover data. Mirroring may be done locally where it is specifically to cater for disk unreliability, or it may be done remotely where it forms part of a more sophisticated disaster recovery scheme, or it may be done both locally and remotely, especially for high availability systems. Normally data is mirrored onto physically identical drives, though the process can be applied to logical drives where the underlying physical format is hidden from the mirroring process.

Typically mirroring is provided in either hardware solutions such as disk arrays or in software within the operating system. As data is written to disk, the system automatically writes a second copy to one or more further locations. The system can either acknowledge that the data is safely written after one drive has confirmed a successful write operation or only when both drives have confirmed, depending on how critical data integrity is, there is normally a performance advantage in not waiting for the second write operation. Data can be read from either disk, and a high performance system would recognise which disk was in a better physical state to retrieve the data most quickly.

There are several scenarios for what happens when a disk fails. In a hot swap system, in the event of a disk failure, the system itself typically diagnoses a disk failure and signals a failure. Sophisticated systems may automatically activate a hot standby disk and use the remaining active disk to copy live data onto this disk. Alternatively, a new disk is installed and the data is copied to it. In less sophisticated systems, the system is operated on the remaining disk until such time as a spare disk can be installed with minimum disruption.

The copying of data from one pair of a mirror to another is sometimes called *resilvering* though more commonly it is simply known as rebuilding. During the rebuilding process, system performance is usually degraded as the disk system is fully occupied in copying data from one disk to the other.

It is often misunderstood that mirroring of disks is a substitute for taking regular backups as it is incorrectly assumed that the only cause of data loss is disk failure. In fact the most trivial of user actions can delete data which then would need to be recovered, and in commercial operations it is far more likely that backups are used to recover from processing errors, user mistakes or vandalism, all of which are not protected by mirroring.

Mirroring can be performed site to site either by rapid data links, for example fibre optic links, which over distances of 500m or so can maintain adequate performance to support real-time mirroring. Longer distances or slower links maintain mirrors using an

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asynchronous copying system. For remote disaster recovery systems, this mirroring may not be done by integrated systems but simply by additional applications on master and slave machines. It is differentiated from a snapshot in that there are no remaining links between the original (or *source*) and the copy (or *mirror*).

Other benefits of mirroring

In addition to providing an additional copy of the data for the purpose of redundancy in case of hardware failure, disk mirroring can allow each disk to be accessed separately for reading purposes. Under certain circumstances, this can significantly improve performance as the system can choose for each read which disk can seek most quickly to the required data. This is especially significant where there are several tasks competing for data on the same disk, and thrashing (where the switching between tasks takes up more time than the task itself) can be reduced. This is an important consideration in hardware configurations that frequently access the data on the disk.

In some implementations, the mirrored disk can be split off and used for data backup, allowing the first disk to remain active. However merging the two disks then may require a synchronization period if any write I/O activity has occurred to the mirrored disk.

Other schemes

Some mirroring schemes employ three disks, with two of the disks for the redundancy mirroring and the third to be split off for performing backups. In EMC nomenclature, the third disk is called a Business Continuance Volume (BCV).

See also

- RAID1
- Disk cloning
- Mirror (computing)

External links

- Going the distance

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Categories: Computer storage

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